

POTOMAC POWER PLANT

On the West Virginia shore of  
the Potomac River about 1 mile  
upriver from the confluence  
with the Shenandoah River.  
Harpers Ferry  
Jefferson County  
West Virginia

HAER No. WV-61

HAER  
WVA  
19-HARF  
30-

PHOTOGRAPHS

Historic American Engineering Record  
National Park Service  
Department of the Interior  
P.O. Box 37127  
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Addendum to:  
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WRITTEN HISTORICAL AND DESCRIPTIVE DATA  
PHOTOGRAPHS  
MEASURED AND INTERPRETIVE DRAWINGS

HISTORIC AMERICAN ENGINEERING RECORD  
NATIONAL PARK SERVICE  
Department of the Interior  
1849 C Street, NW  
Washington, DC 20240

## HISTORIC AMERICAN ENGINEERING RECORD

### Potomac Power Plant

HAER No. WV-61

HAER  
WVA,  
19-HARF,  
30-

**Location:** On the West Virginia shore of the Potomac River about one mile upriver from the confluence with the Shenandoah River, at the end of Potomac Street, Harpers Ferry, Jefferson County, West Virginia.

UTM Coordinates: 18. E264320. N4356280

Quad: Harpers Ferry, West Virginia

**Date of Construction:** 1888, partially rebuilt and reconfigured 1925

**Original Owner:** Thomas Savery

**Present Owner:** Harpers Ferry National Historical Park

**Significance:** The Potomac Power Plant was an innovative small hydroelectric facility that operated from 1899 to 1991, originally as part of a wood pulp mill (built 1888), and solely as a power house after a fire in 1925. Significant extant equipment/machinery in the plant includes a c.1905 Dayton Globe water turbine, and a 1925 Woodward water turbine governor. The building is also symbolic of industry in Harpers Ferry, as it occupies the site (and possibly the partial foundations) of Harpers Ferry National Armory buildings dating to 1834 and 1853, and contains reused structural materials from various Armory buildings as well as from an 1848 Harpers Ferry cotton mill (later a flour mill).

**Project Information:** This project was undertaken by the Historic American Engineering Record (HAER, Eric DeLony, Chief), a long range program to document historically significant engineering and industrial works in the United States. The HAER program is administered by the Historic American Buildings Survey / Historic American Engineering Record Division (HABS/HAER, Blaine Cliver, Chief) of the National Park Service, U.S. Department of the Interior. The Harpers Ferry Potomac Power Plant Project was sponsored by the Harpers Ferry National Historical Park (Donald Campbell, Superintendent, Peter Dessauer, Architect, Bruce Noble, Chief, Interpretation & Cultural Resource Management).

The Harpers Ferry Potomac Power Plant Project was supervised by Christopher Marston, HAER Architect. The field supervisor was Thomas Behrens, HAER Architect, and project team members included architectural interns Lee Clausen (Clemson University), Walton Stowell, Jr. (Savannah College of Art and Design), and Sandra Brezovecki-Bidin (US/ICOMOS - Croatia), and Dean Herrin, HAER Historian. Photographs were taken by Jet Lowe, HAER Photographer.

**Historians:**

Dean Herrin, with additional information in Appendix by Robert C. Stewart, 1998.

## **The History of the Potomac Power Plant**

The Potomac Power Plant in Harpers Ferry, West Virginia is a small industrial building that was once a hydroelectric facility, and now sits as a ruin within a ruin, on the remains of an earlier pulp mill. The current configuration of the structure dates to 1925, but the site, and various structural elements and building materials, date to a period almost a century earlier, when the Harpers Ferry National Armory produced guns for the United States. The power plant, now owned by Harpers Ferry National Historical Park, is composed like a crazy-quilt of elements of earlier eras and various industries. A symbolic (and physical) representation of nineteenth-century industry and technology in Harpers Ferry, the plant was also an early and innovative twentieth-century hydroelectric site. Significant remnants of water power technology and the generation of electricity still exist on site, amid the architectural helter-skelter of the patchwork plant. From metal to pulp to electricity, the various products, transformations and meanings of the site reveal a complex story of technological change, adaptation, and death.

The history of the Potomac Power Plant site dates to 1834, when officials of the Harpers Ferry Armory began construction of a Tilt-Hammer and Barrel-Welding Shop for the musket factory which lined the banks of the Potomac River. The Armory had existed in Harpers Ferry since 1799, and was only one of two armories producing weapons for the United States.<sup>1</sup> The

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<sup>1</sup>See Paul A. Shackel, Culture Change and the New Technology (NY: Plenum Press) 1996, and Merritt Roe Smith, Harpers Ferry Armory and the New Technology (Ithaca, NY:

Tilt-Hammer and Barrel-Welding Shop was situated at the upper end of the musket factory grounds, by the power canal that supplied water power to run the machinery in the armory workshops. This canal, and the dam across the Potomac that fed water into the canal, had been built at the beginning of the nineteenth century. The Tilt-Hammer Shop contained eight tilt-hammers, which were used to work the metal for musket barrels. These hammers were all powered by water, so the shop was built between the canal and the river, with flumes underneath the shop floor to channel water through water wheels.<sup>2</sup>

Little is known about the appearance of this shop. In his 1848 annual report, Armory Superintendent Major John Symington proposed building a new Tilt-Hammer Shop because the structure built in 1834 "has all the defects, but in a greater degree, of the other old shops, which have had to be reconstructed..." He complained that the shop was "dark and badly ventilated, with its floor so low that every freshet covers it, some times to the depth of eight feet." In addition, according to Symington:

There is also now a separate wheel and gearing for each hammer, eight in all, six of which are tub wheels, utterly useless when submerged, having thus lost 28 working days last year, and 52 the year before, besides considerable damage to the perishable parts of the machinery by the frequent floodings. The present forebays and penstocks supplying the wheels are of wood carried through the ground, and

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Cornell University) 1977.

<sup>2</sup>Charles W. Snell, "A Physical History of the Plant of the U.S. Armory at Harpers Ferry, VA, 1794-1885 - Its Evolution, Development, Destruction, etc. - Vol. II, Reconstruction of the Armory, 1842-1851," (April, 1981), located in Harpers Ferry National Historical Park, Library, pp. 133-138.

require frequent repairs, and entire renewal every few years.<sup>3</sup>

Symington's complaints were heeded, and a new tilt-hammer shop was built between 1849 and 1851 east of the old shop.<sup>4</sup> In his 1848 report, Symington also recommended that a rolling mill be erected on the site of the old tilt-hammer shop, "[t]o work up scrap iron into bars of suitable sizes for use in the shops." This plan also was approved, but construction for some reason was delayed until 1853. Benjamin Huger, Superintendent of the Armory in 1853, included in his annual report for that year the following: "The old tilt-hammer shop...has been pulled down, and the [water] wheels, etc., removed; the wheel-pits penstocks, and forebays filled up; and all made ready for building the new rolling-mill on its foundations."<sup>5</sup>

The new rolling mill, then, was constructed on the foundation of the old tilt-hammer shop. The new building was described as "146 ft. x 45 ft., one story of 16 ½ ft., built of brick, on stone foundation..." The rolling mill, tilt-hammers, shears and other machinery in the building were powered by a "water-wheel, 15 feet cube" and "one large cast-iron flume from canal to forebay." Since the new rolling mill included a water wheel, and therefore a wheel-pit, it is unclear why the wheel-pits, penstocks, and forebay of the old tilt-hammer shop were "filled up." Perhaps one

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<sup>3</sup>Ibid, p.133.

<sup>4</sup>Ibid, pp.134-138.

<sup>5</sup>Charles W. Snell, "A Physical History of the Plant of the U.S. Armory at Harpers Ferry, VA, 1794-1885 - Its Evolution, Development, Destruction, etc. - Vol. III, Reconstruction, Destruction and Disposal of the Armory, 1852-1885," (April, 1981), located in Harpers Ferry National Historical Park, Library, p.16.

wheel-pit was left intact, or maybe the size of the new water wheel necessitated a new wheel-pit and forebay.<sup>6</sup>

The rolling mill survived intact for only eight years. As the site of an armory, Harpers Ferry was coveted by both armies in the Civil War. Between 1861 and 1865, the town changed hands at least eight times. The armory buildings were, ironically, first burned by Union soldiers, to prevent their use by Confederates. Subsequent fighting, shelling, looting, and burning reduced all the Armory's structures to ruins. The devastation was so complete that the U.S. Government decided after the war not to rebuild the Armory, finally selling the land and ruins at auction in 1884.<sup>7</sup>

#### Thomas Savery and Pulp Wood

Thomas Savery (1837-1910), a Delaware businessman and inventor of papermaking machinery, submitted the winning bid in October of 1884 for the former U.S. Armory grounds along the Potomac River, the old Hall Rifle Works by the Shenandoah River, and all of the water

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<sup>6</sup>Ibid, pp.15-17; the "water-wheel, 15 feet cube" may have been a water turbine or a conventional water wheel. In 1851-52, Harpers Ferry Armory had purchased five Boyden turbines with cast-iron flumes, and one may have been reserved for the new rolling mill. On the other hand, a list of the Armory's conventional water wheels in 1860 included a 15-foot wooden backshot wheel. See David T. Gilbert, A Walker's Guide to Harpers Ferry, West Virginia, (Harpers Ferry, WV: Harpers Ferry Historical Association, 1995, 5<sup>th</sup> ed.), p.56.

<sup>7</sup>Smith, Harpers Ferry Armory and the New Technology, p.322; Extracts of Minutes of Board of Directors, Harpers Ferry Paper Company, "Miscellaneous," in File, "Harpers Ferry Paper Company," Allegheny Power Records Center, Dunbar, PA.



rights formerly enjoyed by the Armory.<sup>8</sup> Savery was 47 years old at the time, a Quaker, and an official of the Pusey and Jones shipbuilding and papermaking machinery manufacturing company in Wilmington, Delaware. Through his papermaking machinery inventions, Savery helped Pusey and Jones become a leader in the field, and he served as the company's President from 1898 until 1907. In addition to his interests in Harpers Ferry, Savery also later built a paper mill near Denver, Colorado in the 1890s, and another mill in Pennsylvania on the Susquehanna River in 1900.<sup>9</sup>

At Harpers Ferry, Savery recognized the immense water power and timber resources available for the manufacture of ground wood pulp. In the second half of the nineteenth century, the rising cost of rags for papermaking encouraged a search for alternative materials. The use of wood pulp for making paper was first devised in Germany and introduced in America in 1867. Paper made from ground wood pulp was of fairly low quality, quickly became yellow and brittle, and had a short life-span. It lacked the strength, softness, and durability of paper made from rags or from chemical processing of pulp wood. But the relatively low cost of the wood pulp was

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<sup>8</sup>After the purchase, and practically until the Chesapeake & Ohio Canal ceased functioning in the 1920s, Savery had to contend with a running feud with the canal on the neighboring Maryland shore. Officials of the canal contended that Savery did not in fact own the dam, and therefore did not have the right to divert water to his mill and potentially lower the water level in the canal. Beyond a few heated exchanges, however, neither side pressed the issue, and Savery continued to assume ownership of the dam. See Letter, Francis J. Cary to Potomac Light and Power Company, January 12, 1944, unlabeled file, Harpers Ferry Records, Allegheny Power Records Center, Dunbar, PA; and Robert E. Harrigan, *Paper Mills and a Nation's Capital* (Lanham, MD: University Press of America, 1995), pp.92-93.

<sup>9</sup>"Collection History" to Accession 291, Thomas H. Savery Diaries Collection, Hagley Museum and Library, Wilmington, DE (hereafter "Hagley"); and Harrigan, *Paper Mills*, p.87.

ideal for the burgeoning newspaper market, which did not require high-quality paper stock.

Setting up a mill to manufacture wood pulp was relatively inexpensive, furthermore. Pulp mills proliferated in America in the late nineteenth century, from 8 establishments in 1870 to 50 in 1880 to 82 by 1890. A "feeding frenzy had developed." By the latter year, the price of groundwood pulp had fallen to less than one cent per pound.<sup>10</sup>

Establishing a wood pulp mill was inexpensive in part because water supplied the power for such mills. Although steam power was beginning to overtake water power in the United States in the late nineteenth century, pulp and paper mills relied on water not only to turn power turbines but also in several of the pulp and papermaking processes. As late as 1909, 60% of the energy requirements of the pulp and paper industry was supplied by waterpower, the only industry among the leading 102 industries in the country in which waterpower was the principal source of energy.<sup>11</sup> Pulp mills also needed extensive timber resources, and the isolation of such preserves made the shipment of coal for steam engine boilers prohibitive. Savery's company estimated that waterpower was so plentiful at Harpers Ferry that it would only cost the company 5 dollars a year to produce one horse power, whereas coal would produce the same amount for 40 dollars per year. In Harpers Ferry, Savery had both water power and plentiful timber.<sup>12</sup>

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<sup>10</sup>Judith A. McGaw, Most Wonderful Machine: Mechanization and Social Change in Berkshire Paper Making, 1801-1885 (Princeton, NJ: Princeton University, 1987), pp.199-205; and Harrigan, Paper Mills, p.89.

<sup>11</sup>Louis C. Hunter, A History of Industrial Power in the United States, 1780-1930 - Vol. I: Waterpower (Charlottesville, VA: University Press of Virginia, 1979), pp.490-91.

<sup>12</sup>Harrigan, Paper Mills, p.90. There had been, in fact, at least one other attempt to form a paper mill in Harpers Ferry. The Shenandoah Paper Manufacturing Company was organized in

On the banks of the Shenandoah and Potomac Rivers by Harpers Ferry, Thomas Savery built two wood pulp mills. The Shenandoah Pulp Mill was built in 1887, and construction of the Potomac Pulp Mill, also known as the Harpers Ferry Paper Company, began in May of 1888, on the site of the old rolling mill.<sup>13</sup> A local newspaper reported on May 10, 1888 that a large force of men had begun making "excavations for the foundation of a large pulp and paper mill." William Savery, Thomas Savery's eldest son and supervisor of construction of the Potomac mill, recorded in his diary that he laid the first stone of the mill building itself on August 16, 1888. Water was first turned into the mill's flumes in January of 1889, and the first pulp was produced on March 23, 1889.<sup>14</sup>

The Potomac Pulp Mill was a two-story wooden and brick structure, measuring approximately 130 feet by 110 feet, built on stone foundations.<sup>15</sup> The mill contained seven flumes,

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1848 to make paper, but the company failed to attract enough capital to survive. See Harrigan, Paper Mills, p.88.

<sup>13</sup>A letter to Savery from his Harpers Ferry lawyer in 1885 referred to the proposed site of the pulp mill on the Potomac as the old "Tilt Hammer Shop," opposite the Baltimore & Ohio Railroad bridge. (Letter, James D. Butt to Thomas Savery, Oct. 8, 1885, Accession 267, Box II, Folder 8, Savery Collection, Library, Harpers Ferry National Historical Park, Harpers Ferry, WV [hereafter HFNHP].) For information on the Shenandoah Pulp Mill, see HAER No. WV-59, "Shenandoah Pulp Mill," and HAER No. WV-35, "Waterpower on Virginus Island."

<sup>14</sup>*Spirit of Jefferson* (Charlestown, WV), May 8, 1888; *Virginia Free Press* (Charlestown, WV), May 10, 1888; *Virginia Free Press*, June 21, 1888; *Spirit of Jefferson*, October 2, 1888; Diary entry of August 16, 1888, Acc. 330, William Savery Diaries, Savery Collection, Hagley; *Spirit of Jefferson*, January 29, 1889; and Diary entry of May 7, 1889, Acc. 291, Thomas H. Savery Diaries Collection, Hagley.

<sup>15</sup>Sanborn Fire Insurance Map, Harpers Ferry, WV, 1907; and "Report on Examination of Property Owned by the Jefferson Power Company, Shenandoah Pulp Company, Harpers Ferry Paper Company, Harpers Ferry Electric Light & Power Company, all of Harpers Ferry, W. VA."

each 14 feet in width, with stone walls laid in cement.<sup>16</sup> A separate office building stood nearby to the southeast of the mill building, and a boiler house, for heating the mill, was built about 15 feet from the mill on the east side. A "transfer shed" on the west side connected the mill to a spur line of the Baltimore and Ohio Railroad, through which railroad cars were loaded with sheets of wood pulp.<sup>17</sup>

The process of making wood pulp was relatively simple. The first requirement, of course, was wood. The hillsides surrounding Harpers Ferry were covered in timber, and the Harpers Ferry Paper Company obtained wood both from commercial timber firms as well as from local farmers supplementing their incomes. Only poplar and spruce wood were used at first, and spruce in particular was a favorite because of its "long fibers, softness, and whiteness."<sup>18</sup> As these woods diminished in the nearby forests, however, pine became a staple wood. By 1919, the mill's wood supply was 40% pine, 40% poplar, and 20% spruce, plus odd lots of maple and hemlock.<sup>19</sup>

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[dated Sept. 16, 1919], p.5, in Acc. 1534, Box 4, Folder 7, Savery Family Collection, Hagley.

<sup>16</sup>"Report on Proposed Potomac River Dam," [dated Oct. 26, 1926], p.1, in Acc. 267, Box II, Folder 8, Savery Collection, HFNHP.

<sup>17</sup>*Spirit of Jefferson*, December 27, 1904.

<sup>18</sup>Harrigan, Paper Mills, p.88; and Harpers Ferry Paper Company, General Manager's Report, Dec. 28, 1921, in Acc. 267, Box II, Folder 1, Savery Collection, HFNHP.

<sup>19</sup>"Report on Examination of Property Owned by the Jefferson Power Company, Shenandoah Pulp Company, Harpers Ferry Paper Company, Harpers Ferry Electric Light & Power Company, all of Harpers Ferry, W. VA." [dated Sept. 16, 1919], p.6, in Acc. 1534, Box 4, Folder 7, Savery Family Collection, Hagley. The amount of pulp obtained from a cord of wood varied. In 1913, officials of the Harpers Ferry pulp mills calculated that one cord of wood produced 1,800 pounds of dry pulp. Pine wood produced about 300 pounds less of pulp per cord than spruce, but pine was five to seven dollars per cord cheaper. See Letter, G.R. Bready,

Most wood arrived at the mill by railroad, from which it was floated in the power canal to a "log-haul." The log-haul moved the wood into the second floor of the mill to the "barking" room floor. Here the bark was stripped from the wood, and the logs were cut into 4 foot lengths, 8-14 inches in diameter (although much of the wood arrived in the prescribed length.) From the barking room the wood was dropped by gravity one floor to the grinder room, where wood grinders reduced the logs to fibers. This was accomplished through water power. Water entered the mill's flumes from the power canal, and in the process of dropping approximately 24-25 feet, turned the runners of various types of water turbines. The turbines were directly connected to the wood grinders. Workers in the mill placed the logs into the grinders, and a revolving stone, powered by a water turbine, ground the log into small fibers.<sup>20</sup> The fibers mixed with water during the grinding process to become a pulp, which was then transported back to the second floor of the mill, moved across screens to separate fibers from larger wood slivers, and formed into sheets of pulp on "wet machines." These sheets were then ready for shipment.<sup>21</sup>

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General Manager of Shenandoah Pulp Mill to William H. Savery, March 19, 1913, Acc. 1534, Box 4, Folder 2, Savery Family Collection, Hagley; and Letter, no signature (presumably William H. Savery) to Thomas H. Savery, Jr., March 4, 1922, Acc. 1534, Box 2, Folder 3, Savery Family Collection, Hagley.

<sup>20</sup>Stones in the wood grinders had to be periodically replaced. The General Manager of the Harpers Ferry Paper Company reported in 1922, for example, that a stone in one grinder was being replaced after two years, three months of service. (Harpers Ferry Paper Company, General Manager's Report, Oct. 21, 1922, Acc. 267, Box II, Folder 2, Savery Collection, HFNHP.) As historian Jack Bergstresser noted in HAER No. WV-35, "Waterpower on Virginus Island," (page 30, note 86), fragments of these used grinding stones can be found on the river bank by the Potomac Power Plant.

<sup>21</sup>*Spirit of Jefferson*, October 2, 1888; "Report on Examination of Property Owned by the Jefferson Power Company, Shenandoah Pulp Company, Harpers Ferry Paper Company, Harpers

Fire insurance maps of the mill produced between 1894 and 1922 show that the pulp-making machinery in the mill changed very little during this time. Throughout this period, the mill's machinery was listed as six wet machines, either eight or four grinders, two barkers, one wood splitter, and one circular saw. There were eight grinders listed on the 1894 and 1902 maps, and only four listed on the maps for 1907 and thereafter.<sup>22</sup> A company report in 1919 gave a little more detail on some of the machinery, calling the grinders "3-pocket Pusey & Jones" grinders, and the wet machines "62" Pusey & Jones" machines.<sup>23</sup>

As in any industrial plant, especially one at the turn of the century, transforming wood into pulp could be dangerous. Many fingers were lost in the barking machines, circular saws, and other machinery. In 1891, for example, a nineteen-year-old worker by the name of Baker Steadman had several fingers cut off in a machine that split logs. Bad luck seemed to run in his family since his brother had previously suffered a similar accident. George Edwards, in 1909, had an arm caught and badly damaged in one of the machines, and one of the luckiest unlucky workers was Charles Gray, who, in 1916, got caught in one of the rollers of a wet machine, and was actually rolled between the big revolving drums. Gray was somewhat pressed, but

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Ferry Electric Light & Power Company, all of Harpers Ferry, W. VA." [dated Sept. 16, 1919], pp.5-6, in Acc. 1534, Box 4, Folder 7, Savery Family Collection, Hagley; Sanborn Fire Insurance Maps, Harpers Ferry, WV, 1894, 1902, 1907, 1912, and 1922.

<sup>22</sup>Sanborn Fire Insurance Maps, Harpers Ferry, WV, 1894, 1902, 1907, 1912, and 1922.

<sup>23</sup>"Report on Examination of Property Owned by the Jefferson Power Company, Shenandoah Pulp Company, Harpers Ferry Paper Company, Harpers Ferry Electric Light & Power Company, all of Harpers Ferry, W. VA." [dated Sept. 16, 1919], p.4, in Acc. 1534, Box 4, Folder 7, Savery Family Collection, Hagley.

miraculously not killed.<sup>24</sup>

For their labors, workers in the Shenandoah and Potomac pulp mills received a relatively small wage, although the evidence is scant. For example, although other day laborers in the Harpers Ferry region reportedly received \$2.00 and \$2.25 per ten-hour day in 1917, workers in the pulp mills received only \$1.70.<sup>25</sup> Wage issues led to at least three strikes in one or both mills, in 1906, 1917, and 1918.<sup>26</sup>

The Saverys' mill on the Potomac made ground wood pulp for 36 years, from 1889 until 1925. Whether they ever made much of a profit from the pulp is questionable. Even as early as 1890, only a year after the Potomac Pulp Mill began operation, the pulp market was so saturated that the price of ground wood pulp was less than one cent per pound. As local forests were depleted and chemically-produced wood pulp began to come into the market, the industry tilted in favor of large, capital-intensive, high-volume companies. Small mills like the one in Harpers Ferry were hard-pressed to compete.<sup>27</sup>

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<sup>24</sup>*Virginia Free Press*, November 11, 1891; and *Farmers' Advocate*, January 23, 1909, and June 3, 1916.

<sup>25</sup>*Farmers' Advocate*, May 12, 1917.

<sup>26</sup>*Spirit of Jefferson*, April 24, 1906; *Farmers' Advocate*, May 12, 1917, and November 9, 1918. One former mill worker, evidently down on his luck, decided to take bold action. He showed up one day in 1901 at the home of Thomas Savery in Wilmington, Delaware, hoping to "interview" Savery for some money and another job. The elder Savery was out of the country at the time, but one of Savery's sons had the local police escort the worker out of town. (Letter, Thomas H. Savery, Jr. to Parents, May 28, 1901, Acc.1534, Box 1, Folder 2, Savery Family Collection, Hagley.)

<sup>27</sup>Harrigan, *Paper Mills*, p.89.

The Harpers Ferry Paper Company apparently did produce a small annual profit until the 1920s, however. Figures for 1903 to 1907 show net profits of from \$5,045 in 1906 to \$18,993 in 1907, and the annual report for 1912 states the company earned a profit of 11% over operating expenses.<sup>28</sup> But by the 1920s, the most crucial raw material for producing pulp - wood - became more scarce. The General Manager's report for 1924 stated: "It will be necessary to make arrangements to finance several hundred cords of wood, as we must take it while we can get it - otherwise we will certainly be shut down for wood, as our local supply is almost exhausted."<sup>29</sup> Earlier, in 1922, Thomas Savery, Jr. wrote in a letter to his brother William Savery, then head of the Saverys' Harpers Ferry operations, that their wood pulp mills alone were "very unattractive to the general investing public." In 1928, a company official claimed that the earnings of the Saverys' companies in Harpers Ferry "have been practically nil in the past."<sup>30</sup>

In addition to their financial situation, the Harpers Ferry Paper Company had periodically been forced to deal with environmental concerns. In 1901, the Harpers Ferry Paper Company brought suit against a neighboring ore mining company, claiming the firm's ore washer discolored

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<sup>28</sup>Harpers Ferry Paper Company [announcement of new bond issue], June 15, 1908, in File, "Harpers Ferry Paper Company," Allegheny Power Records Center, Dunbar, PA; Harpers Ferry Paper Company, Annual Report, 1912, Acc. 1534, Box 4, Folder 1, Savery Family Collection, Hagley.

<sup>29</sup>Harpers Ferry Paper Company, General Manager's Report, Feb. 7, 1924, Acc. 267, Box II, Folder 4, Savery Collection, HFNHP.

<sup>30</sup>Letter, Thomas H. Savery to William H. Savery, April 4, 1922, Acc. 1534, Box 2, Folder 3, Savery Family Collection, Hagley; Letter, Francis R. Taylor to William H. Savery, August 1, 1928, Acc. 1534, Box 4, Folder 2, Savery Family Collection, Hagley.



the Potomac River above the pulp mill, ruining sheets of pulp made at the mill.<sup>31</sup> A judge decided in favor of the Harpers Ferry Paper Company, but years later, in 1925, the company finally purchased the ore mine property, placing in the minutes of a meeting of the Board of Directors the complaint that the site "in past years has been a source of irritation to the Company, as upon numerous occasions it had been necessary to shut down the pulp mills and dispose of pulp mixes due to contamination of the water."<sup>32</sup> On the other hand, the pulp mill was forced to build an incinerator in 1905 to burn its waste when a downstream fishing club complained that pulp waste emptied into the Potomac was decimating fish in the river.<sup>33</sup>

The Potomac River was also the source of other trouble for the pulp mill. The river provided the water power that the mill depended upon, but it also frequently flooded Harpers Ferry and the region, disrupting mill operations and frequently damaging the dam, canal race, and other features of the mill property. Only three months after the first pulp was made in the Potomac mill, the flood of 1889 almost destroyed the entire enterprise. The minutes of the Harpers Ferry Paper Company recited the devastation, which included the small office structure

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<sup>31</sup>Undated partial report, Acc. 1534, Box 1, Folder 2, Savery Family Collection, Hagley; unidentified newspaper clipping (c.1901), Acc. 1534, Box 4, Folder 10, Savery Family Collection, Hagley.

<sup>32</sup>"Extracts of Minutes of Board of Directors, Harpers Ferry Paper Company," Dec. 4, 1925, in File, "Harpers Ferry Paper Company," Allegheny Power Records Center, Dunbar, PA.

<sup>33</sup>Appendix E, Minutes of Harpers Ferry Paper Company, May 26, 1904, in "Harpers Ferry Paper Company to Potomac Light and Power Company," (c.1940s), in File, "Harpers Ferry Paper Company," Allegheny Power Records Center, Dunbar, PA; *Farmers' Advocate*, Oct. 22, 1904; *Spirit of Jefferson*, November 1, 1904; see also *Farmers' Advocate*, Oct. 29, 1904, and March 11, 1905.

for the mill being swept downriver:

The Mill lost much time repairing damages. The Dam across the Potomac was found to be a complete wreck and it was found impossible to maintain anything like the former head of water without extensive repairs to the Dam and they were begun at once. The race bank was also considerably damaged by the high water which completely submerged the bank washing off a large part of the earth covering.<sup>34</sup>

Other floods followed, forcing the company to spend considerable money over the years to repair the dam and other features of the water power system.<sup>35</sup>

On January 14, 1925, the manufacture of ground wood pulp in the Potomac Pulp Mill ceased forever. An early-morning fire, fueled in part by three carloads of pulp on the first floor, gutted the mill. Mill and fire insurance officials determined the cause of the fire to be a faulty generator, which sparked and set the roof timbers on fire. With the help of a \$25,000 insurance policy payment, the Harpers Ferry Paper Company rebuilt a smaller version of the mill, but not to continue the manufacture of wood pulp. Instead, the company turned exclusively to an ancillary business that had grown to overshadow pulp-making - the generation of electricity.<sup>36</sup>

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<sup>34</sup>Appendix E, Minutes of Harpers Ferry Paper Company, Feb. 6, 1890, in "Harpers Ferry Paper Company to Potomac Light and Power Company," (c.1940s), in File, "Harpers Ferry Paper Company," Allegheny Power Records Center, Dunbar, PA.

<sup>35</sup>"Harpers Ferry - Potomac River Dam No. 3 Rehabilitation Study," (May 1980), pp.5-6, in File, "File #4 - Harpers Ferry 2515," Potomac Edison Company, Hagerstown, MD; *Farmers' Advocate*, Feb. 23, 1918.

<sup>36</sup>*Farmers' Advocate*, Jan. 17, 1925; Letter, no signature (presumably William H. Savery) to C. R. Thatcher, West Chester, PA, Jan. 20, 1925, Acc. 267, Box II, Folder 15, Savery Collection, HFNHP.

## Generation of Electricity

The first water-powered central electrical station opened in Wisconsin in 1882, but it was the spectacular development of the hydro plant at Niagara Falls in 1895 that started a boom in hydroelectric development nationwide. For a decade after 1895, water power increased faster than steam power as the energy source for central stations, and the energy produced by hydroelectric power doubled between 1912 and 1920.<sup>37</sup>

Thomas Savery and the Harpers Ferry Paper Company realized as early as 1898 that the energy produced by the water turbines in their pulp mills was potentially a valuable commodity itself. The idea of converting part of the Potomac Pulp Mill into a small hydroelectric plant seems to have originated with the paper company officials, and while it is unknown if the developments at Niagara Falls influenced their thinking, it is reasonable to assume they were generally aware of the new national interest in hydroelectric power. In March of 1898, a local newspaper reported the company was considering an electric power plant:

The Pulp Mills at Harpers Ferry have a maximum capacity of 4,000 hp, and for some time the owners have considered the question of turning half of this power into an electric power plant, to supply the different industries at Charles Town and vicinity, with all the power necessary to run their plants as well as lighting Harpers Ferry and Charles Town.<sup>38</sup>

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<sup>37</sup>Louis C. Hunter, A History of Industrial Power in the United States, 1780-1930 - Vol. III: The Transmission of Power (Cambridge, MA: MIT, 1991), pp. 352-53.

<sup>38</sup>*Spirit of Jefferson*, March 22, 1898.

The company seems at first to have only considered leasing the water power for hydroelectric generation. Newspapers in 1898 reported various parties interested in purchasing water power from the Harpers Ferry Paper Company, and in October of that year, they stated that John Livers from Gettysburg, Pennsylvania had obtained a franchise from the town of Harpers Ferry to supply electric lights, and had leased 80 horsepower from the pulp mill to drive the machinery of the new electric plant. At the end of October, preparations were being made to place a dynamo in the pulp mill for the electric plant, and by the middle of January of 1899, new arc street lamps were burning in Harpers Ferry.<sup>39</sup>

The Harpers Ferry Paper Company changed direction somewhat in the Spring of 1899, and purchased the new electric plant in May, establishing Thomas Savery as President of the new Harpers Ferry Electric Light and Power Company (HFEL&P Co.).<sup>40</sup> A year later, in February of 1900, the local newspaper the *Farmers' Advocate* reported that HFEL&P Co. wanted to generate electricity for not only Harpers Ferry but for all of the surrounding area, including Charlestown, Shepherdstown, and Martinsburg in West Virginia, and Winchester in Virginia.<sup>41</sup> The expansion of the company actually occurred in the other direction, towards Maryland. Brunswick, Maryland, an active railroad center for the Baltimore and Ohio Railroad, was hooked into the HFEL&P Co. system in 1904, and remained the company's largest market throughout its

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<sup>39</sup>*Farmers' Advocate*, April 23, 1898; Oct. 15, 1898; and Jan. 14, 1899; *Spirit of Jefferson*, Oct. 25, 1898; and Dec. 6, 1898; *Virginia Free Press*, Oct. 26, 1898.

<sup>40</sup>*Spirit of Jefferson*, May 30, 1899, and July 18, 1899; *Virginia Free Press*, May 31, 1899.

<sup>41</sup>*Farmers' Advocate*, Feb. 3, 1900.

existence.<sup>42</sup>

In converting some of its mill power to hydroelectric generation, the Harpers Ferry Paper Company was in the vanguard of a conversion that became common to pulp and paper mills. According to one historian of the hydroelectric industry,

The gradual shift from mechanically ground to chemically digested wood pulp during the first years of this century left many paper companies with un-utilized water turbines in retired pulp mills. Conveniently, pulp grinders required relatively high shaft speeds in order to operate - so did generators. Pulp grinders also occupied about the same amount of floor space as commonly available generating equipment. Quite a few paper companies created hydroelectric plants by simply unbolting and discarding obsolete pulp grinders, then mounting alternators in their place. Electricity was used for lighting and to power machines.<sup>43</sup>

Thomas Savery and his associates ran both the Harpers Ferry Paper Company and the Harpers Ferry Electric Light and Power Company, but maintained legally separate entities for the two operations. The HFEL&P Co. presumably continued to lease water power from the paper company after 1900, but the first formal contract between the two companies is dated May 25, 1905. In this contract, the Harpers Ferry Paper Company agreed to lease to the HFEL&P Co. flume #6 in the mill building to run water for electric generation from 6:00 pm until 6:00 am, at a rate of 50 cents per horsepower per month. A 1910 renewal of the contract specifies that the

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<sup>42</sup>*Farmers' Advocate*, November 26, 1904.

<sup>43</sup>Duncan Hay, Hydroelectric Development in the United States, 1880-1940 (Washington, DC: Edison Electric Institute, 1991), p.34.

space in the mill building leased to the HFEL&P Co. is 20 feet by 26 feet in the southeast corner of the machine room. A new contract in 1916 gave the electric company the right to use the flume from sunrise to sunset.<sup>44</sup>

By 1913, the HFEL&P Co. had 305 customers, providing power for 4,869 interior lights and 92 street lamps.<sup>45</sup> Business continued to expand, and in 1916, stockholders of the company voted to make about \$17,000 in improvements - a new generator, new meters for consumers, and the construction of a third transmission line between Harpers Ferry and Brunswick.<sup>46</sup> By 1921, the number of customers had jumped to 1,023, and a new generator was added in 1923 to handle the additional load.<sup>47</sup>

By the 1920s, the Savery brothers and other officials of the Harpers Ferry pulp mills and electric plant realized that the electricity-generating capacity of the mills was much more valuable than the manufacture of wood pulp. In a letter to his brother William, Thomas Savery, Jr. wrote in 1922,

There is one thing to remember and that is the WHEELS used by the Elect. Light Co., are income producers when water is high, low, muddy or otherwise when

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<sup>44</sup>Acc. 267, Box III, Folder 9, Savery Collection, HFNHP.

<sup>45</sup>"Census of Electric Light & Power Stations 1912, Harpers Ferry Electric Light & Power Co., 1912 to 1913," Acc. 1534, Box 4, Folder 5, Savery Family Collection, Hagley.

<sup>46</sup>*Farmers' Advocate*, Jan. 8, 1916.

<sup>47</sup>Extract of Minutes of Board of Directors, Harpers Ferry Electric Light and Power Company, May 25, 1921, and April 23, 1924, in File, "Harpers Ferry Electric Light & Power," Allegheny Power Records Center, Dunbar, PA; *Farmers' Advocate*, July 14, 1923.

Pulp cannot be made and in a general way our properties have a greater value due to the present Electric development and would otherwise be very unattractive to the general investing public.<sup>48</sup>

But it was also apparent in the 1920s that the Saverys and their associates either did not have the capital, or did not want to spend the capital, to maximize the potential of their site. Their customers remained nearby towns needing street lights and homes and businesses needing interior lights. Although the company made efforts to attract factories to the region, a consultant's evaluation of the company in 1928 claimed that the HFEL&P Co. had made little attempt to attract large power consumers "due to the lack of available capital to increase the power plant capacity to take care of large power loads."<sup>49</sup> The Saverys, at least, seemed to have another plan. In 1922, Thomas Savery, Jr. confided to his brother William, "We all appreciate that we must keep on developing the Power company and hope that that will be bait for some people to buy us out in near future."<sup>50</sup> A few months later, William indicated his agreement: "I have no doubt we could readily sell out the Electric Co., as we show 20% profit. What I am

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<sup>48</sup>Letter, Thomas H. Savery to William H. Savery, April 4, 1922, Acc. 1534, Box 2, Folder 3, Savery Collection, Hagley.

<sup>49</sup>Cultural Landscape Report, Virginus Island, Harpers Ferry National Historical Park (U.S. Dept. of the Interior, 1993), Part 3, page 76 (1924 magazine advertisement); William E. Vogelback, "Report and Appraisal - Harpers Ferry Electric Light and Power Company - January 1928," p.7, Acc. 915, Box 7, Savery Collection, Hagley.

<sup>50</sup>Letter, Thomas H. Savery to William H. Savery, April 4, 1922, Acc. 1534, Box 2, Folder 3, Savery Collection, Hagley.

working for is to sell ALL the holdings here in a lump..."<sup>51</sup>

The fire of 1925 may seem to have damaged the Saverys' plans, but the blaze in fact was beneficial. The fire conveniently eliminated the least profitable part of their operation, pulp-making, and with the fire insurance payment, allowed the brothers and their associates to rebuild a smaller and modernized plant more suited solely to hydroelectric generation. The new mill building was completed by June of 1925, new electrical equipment was added later that year, and the search for a buyer continued.<sup>52</sup>

More problematical than the fire was the state of the HFEL&P Co.'s bookkeeping, and the prospects for expansion of the region's electric service. A consultant's report in 1928 complained that the accounting records for the HFEL&P Co. were in such a disarray that it was impossible to determine what the past earnings had been. There may have been a reason for the disarray. Another report in 1928 revealed: "Due to apparent mismanagement and misappropriation of funds on the part of the former superintendent, the operating expenses reported are out of their proper proportion and apparently not in accordance with the facts."<sup>53</sup> Furthermore, expansion did not look promising. The company's lines were in bad shape, and at most, HFEL&P Co. was selling only 1 million kilowatt hours of electricity, which was a very small amount. The nearby town of Hagerstown, Maryland had just opened a new municipal

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<sup>51</sup>Letter, no signature (presumably William H. Savery) to Thomas H. Savery, Jr., August 5, 1922, Acc. 1534, Box 2, Folder 3, Savery Family Collection, Hagley.

<sup>52</sup>*Farmers' Advocate*, May 23, 1925, and Sept. 5, 1925.

<sup>53</sup>Vogelback, "Report and Appraisal...", p.11.



electric plant and therefore would not buy any power from HFEL&P Co.; the larger Potomac Edison power company had just opened a new and efficient plant in Williamsport, Maryland which generated electricity for about 5 mills; and another regional power company, the Potomac Electric Power Company of Washington, DC, would not be interested in supplementing its service with HFEL&P Co.'s small supply. With Savery and his associates unwilling or unable to significantly infuse the Potomac plant with new capital, an associate wrote to William Savery in August of 1928 that "the ultimate sale of the Company...is the only logical outcome."<sup>54</sup>

Expansion appeared unlikely for HFEL&P Co., but the company still possessed a regional niche. By 1928, HFEL&P Co. provided electricity to Harpers Ferry and Bolivar in West Virginia, and Brunswick, Knoxville, Sandy Hook, Weverton, Rosemont, Yarrowsburg, and Brownsville in Maryland. The number of consumers had risen from 1,467 in 1924 to 1,707 in 1926, and the kilowatt hours of electricity sold by the company had risen from just under 400,000 in 1920 to over 830,000 in 1926.<sup>55</sup>

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<sup>54</sup>Letter, Charles C. Dawes to William H. Savery, June 13, 1928, and Letter, Francis R. Taylor to William H. Savery, August 1, 1928, in Acc. 1534, Box 4, Folder 2, Savery Family Collection, Hagley.

<sup>55</sup>Vogelback, "Report and Appraisal...", pp.4,7. The following chart shows the number of customers for HFEL&P Co.'s electricity from 1924 to 1926, by town (from Vogelback, "Report and Appraisal...", p.7):

	<u>1926</u>	<u>1925</u>	<u>1924</u>
Harpers Ferry and Bolivar	342	330	311
Sandy Hook and Weverton	97	90	62
Knoxville	107	92	96
Brunswick	1,088	1,012	970
Rosemont	36	26	28
Yarrowsburg and Brownsville	<u>37</u>	<u>13</u>	=

The Saverys and their associates achieved their goal of selling the company on August 15, 1928, when the National Electric Power Company, a subsidiary of the Virginia Public Service Company, purchased HFEL&P Co., the Harpers Ferry Paper Company, and the Shenandoah Pulp Company for \$1,100,000.<sup>36</sup>

The subsequent ownership of the Potomac electric plant is unclear from the surviving evidence, but it seems that in 1931, the Virginia Public Service Co., headquartered in Alexandria, Virginia, purchased from the National Electric Power Company its Harpers Ferry properties, but

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1,707	1,563	1,467
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The company sold the following kilowatt hours of electricity per year (from Vogelback, "Report and Appraisal...", p.7):

1920	398,512
1921	475,714
1922	472,500
1923	641,100
1924	653,300
1925	650,630
1926	830,010

<sup>36</sup>Minutes of Board of Directors, Aug. 15, 1929, Acc. 1534, Box 4, Folder 1, Savery Family Collection, Hagley; undated paper titled "Harpers Ferry Paper Company Purchase," in File, "Harpers Ferry Paper Co.," Allegheny Power Records Center, Dunbar, PA; Extracts of Board of Directors, Shenandoah Pulp Company, August 15, 1929, in File, "Harpers Ferry Paper Co.," Allegheny Power Records Center, Dunbar, PA; *Farmers' Advocate*, August 24, 1929. The new owners moved the office of the power plant in 1929 into the Ashton Jones Building on Shenandoah Street in Harpers Ferry, and according to one newspaper, intended to operate a store for electrical appliances. See *Farmers' Advocate*, Oct. 5, 1929, and *Spirit of Jefferson*, Oct. 10, 1929.

not any of the Maryland properties.<sup>57</sup> In May of 1934, the properties of the HFEL&P Co. were split between the Potomac Edison Company and the Virginia Public Service Company.<sup>58</sup> In June of 1934, the Potomac hydroelectric plant was leased to the Potomac Light and Power Co., a predecessor of the Potomac Edison Co. of West Virginia, later part of the Potomac Edison Company.<sup>59</sup> In 1939, the hydroelectric plant was leased back to the Virginia Public Service Company. Four years later, in 1943, the Virginia Public Service Company sold the plant to the Potomac Light & Power Co.<sup>60</sup> In 1944, the Potomac Light & Power Company acquired the dam at Harpers Ferry from the Harpers Ferry Paper Company, still a legal entity, and "merged" the old paper company within the power company's operations.<sup>61</sup> The Potomac Light & Power

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<sup>57</sup>Extracts of Minutes of Board of Directors, Harpers Ferry Paper Company, "Miscellaneous", and Dec. 6, 1930, in File, "Harpers Ferry Paper Co.," Allegheny Power Records Center, Dunbar, PA.

<sup>58</sup>"Annual Report of Harpers Ferry Electric Light & Power Company to the Public Service Commission of West Virginia for 1934," p.27, Potomac Edison Company, Hagerstown, MD.

<sup>59</sup>Extracts of Minutes of Board of Directors, Harpers Ferry Paper Company, June 26, 1934, in File, "Harpers Ferry Paper Co.," Allegheny Power Records Center, Dunbar, PA.

<sup>60</sup>Extracts of Minutes of Board of Directors, Harpers Ferry Paper Company, May 1, 1939, and July 7, 1943, in File, "Harpers Ferry Paper Co.," Allegheny Power Records Center, Dunbar, PA.

<sup>61</sup>Letter, William H. MacMullen, Potomac Light & Power Co., to F.L. Morgal, Nov. 8, 1965, and Letter, William H. MacMullen, Secretary, Potomac Light & Power Co. to F. Stewart Brown, Chief, Bureau of Power, Federal Power Commission, Nov. 10, 1965, in File, "File #4 - Harpers Ferry 2515," Potomac Edison Company, Hagerstown, MD. The Shenandoah Pulp Company was dissolved by the Harpers Ferry Paper Company in June of 1936, "[d]ue to continued losses in business..." A 1934 HFEL&P Co. report stated that the mill on the Shenandoah "is not making any money, and is being run in order to provide employment for the residents of [Harpers Ferry and Bolivar]." See Extracts of Minutes of Board of Directors, Harpers Ferry Paper Company, June 23, 1936,, in File, "Harpers Ferry Paper Co.," Allegheny

Company later became a part of the Potomac Edison Company, which in turn became part of Allegheny Power.

The Potomac Power Plant continued serving the local community until 1991, operating mostly as an unmanned plant, checked and serviced by a crew from another Potomac Edison plant nearby.<sup>62</sup> By the 1990s, the small power output of the Harpers Ferry plant was no longer cost-efficient. One of the two turbine-generator units stopped functioning in 1969, and was officially retired in 1973. The second turbine-generator unit, the last water-powered machinery in Harpers Ferry, was shut down in 1991.<sup>63</sup> The Harpers Ferry National Historical Park, a unit of the National Park Service, currently owns the site, and has proposed tentative plans to preserve and interpret the structure.

### **The Architecture and Technology of the Potomac Power Plant**

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Power Records Center, Dunbar, PA; undated report (c.1934), "Harpers Ferry Electric Light and Power Company," in File, "Harpers Ferry Electric Light & Power," Allegheny Power Records Center, Dunbar, PA; and Extracts of Minutes of Board of Directors, Shenandoah pulp Company, August 15, 1929, in File, "Harpers Ferry Paper Company," Allegheny Power Records Center, Dunbar, PA.

<sup>62</sup>"Harpers Ferry - Potomac River Dam No. 3 Rehabilitation Study," (May 1980), p.4, in File, "File #4 - Harpers Ferry 2515," Potomac Edison Company, Hagerstown, MD.

<sup>63</sup>"United States of America, Federal Power Commission, Instrument No. 3, Order Approving Revised Exhibit L and Amending License, Potomac Edison Company of West Virginia, Project No. 2515, Issued September 24, 1973, in File, "File #4 - Harpers Ferry 2515," Potomac Edison Company, Hagerstown, MD.

The building that housed the Potomac Power Plant is a small, unpretentious brick industrial building dating for the most part to 1925, and measuring roughly 74 feet by 42 feet. To the casual observer, the old power plant looks like a hundred other nondescript industrial structures. In fact, the building is an icon of Harpers Ferry industry, and like a crazy-quilt, is composed of fragments of significant meaning.

The site of the power plant is historic, having been occupied by first the Harpers Ferry Armory's Tilt-Hammer Shop, built in 1834, and later by the Armory's new Rolling Mill, constructed in 1853. Although there is some evidence that Thomas Savery constructed new foundations for his pulp mill, he built the mill on the site previously occupied by both the Tilt-Hammer Shop and the Rolling Mill, and may have reused parts of the foundations for these structures for his new mill.<sup>64</sup> The waste weir to the west of the power plant building may also contain historic elements. A map from the mid-1830s shows both the old Tilt-Hammer Shop and a waste weir, in the approximate location of the current waste weir.<sup>65</sup>

Savery also presumably reused bricks from the ruined Armory buildings in erecting his new pulp mill. He had earlier reused bricks from the old rifle factory on Hall's Island to build the foundation for his pulp mill on the Shenandoah River, and his son William was quoted in a local

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<sup>64</sup>Savery dynamited the ruins of the old government buildings on the Potomac River in 1887 to make room for his mill. See *Virginia Free Press*, November 3, 1887.

<sup>65</sup>*Spirit of Jefferson*, May 8, 1888; Diary entries for Aug. 16 and Oct. 26, 1888, Acc. 330, William Savery Diaries, Savery Collection, Hagley; *Virginia Free Press*, May 10, 1888; *Farmers' Advocate*, March 7, 1925; Letter, James D. Butt to Thomas Savery, Oct. 8, 1885, Acc. 267, Box II, Folder 8, Savery Collection, HFNHP; Map, "Proposed Route of Baltimore & Ohio Railroad," c.1834-36, Drawer #2, Library, Harpers Ferry National Historical Park, Harpers Ferry, WV.

newspaper in 1888, referring to the building of the Potomac Pulp Mill, that, "We...will tear down all the rest of the old works and use the brick in our new mills."<sup>66</sup>

Building materials, in fact, were often reused in Harpers Ferry. Bricks from the ruins of the old rifle factory on Hall's Island were salvaged for the Methodist Protestant Church on Camp Hill and both the McGraw store and residence on Shenandoah Street, and Storer College's Lincoln Hall, a dormitory which was rebuilt after a fire in 1909, reused bricks from an old flour mill on Virginius Island.<sup>67</sup>

After the 1925 fire destroyed part of the Potomac Pulp Mill, the Harpers Ferry Paper Company again reused bricks from another structure to rebuild the mill. The fire gutted most of the interior of the pulp mill, and collapsed the north wall. Two months after the fire, the remains of the west wall were demolished when high winds swept down the Potomac. Among the property owned by the company in Harpers Ferry was Virginius Island, which at one time had supported numerous industrial structures. The Child & McCreight Flour Mill had been built on Virginius Island in 1848, originally as a cotton factory. In 1925, after the fire, laborers for the paper company were paid for "tearing down part of the walls of the old Flour Mill and in cleaning the bricks used to construct a new wall on north and west side of Power House."<sup>68</sup>

The Potomac Power Plant building, therefore, may be built on parts of the foundations of

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<sup>66</sup>Harrigan, Paper Mills, p.87; *Spirit of Jefferson*, Oct. 2, 1888.

<sup>67</sup>Cultural Landscape Report, Virginius Island, Harpers Ferry National Historical Park, Part 3, page 79; *Spirit of Jefferson*, April 27, 1909.

<sup>68</sup>*Farmers' Advocate*, March 28, 1925; Letter, no signature (presumably William H. Savery), to C.R. Thatcher, June 6, 1925, Acc. 267, Box II, Folder 6, HFNHP.

the 1834 Tilt-Hammer Shop and 1853 Rolling Mill, and contain foundation stones and wall bricks from any number of former Armory structures, as well as bricks from an 1848 cotton factory and flour mill on Virginus Island.<sup>69</sup> Considering that the site was also the last of the water-powered operations of Harpers Ferry, the Potomac Power Plant is significant not only as an interesting hydroelectric facility, but also as a patchwork "true piece of the cross," containing structural elements both symbolic and real of Harpers Ferry's gloried industrial past.

The industry of Harpers Ferry owed its existence to water power, from the energy inherent in the flowing of the Potomac and Shenandoah Rivers. Throughout the nineteenth century, both private and government industry in Harpers Ferry established dams, power canals, raceways, and waterwheel and turbine installations to power a vast assortment of machinery. When Thomas Savery purchased the old Armory works on the Potomac, he inherited a stone-filled crib dam, first constructed in 1799 and replaced in 1828, running across the river for 1,575 feet, and a long power canal that brought water to his mill site, and dropped it 25 feet on its path back into the Potomac River. The power canal varied in width from 50 to 100 feet, with a depth of from 15-20 feet. A sluice gate and overflow weir was located at the end of the power canal, near the mill site, to drain the canal and help control the water level.<sup>70</sup>

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<sup>69</sup>The north and west walls of the power house were rebuilt with bricks from the 1848 cotton/flour mill, and the south and east walls are mostly from the 1888 pulp mill construction, which reused bricks from the original Armory structures.

<sup>70</sup>"Harpers Ferry - Potomac River Dam No. 3 Rehabilitation Study," (May 1980), pp.3-5, in File, "File #4 - Harpers Ferry 2515," Potomac Edison Company, Hagerstown, MD; "Report on Examination of Property Owned by the Jefferson Power Company, Shenandoah Pulp Company,

The 25-foot fall (or head) of water at the mill site produced the energy to run machinery, and Savery constructed his new pulp mill with seven flumes to capture this latent energy. The exact number, type, and configuration of the various water turbines employed in the Potomac Pulp Mill is unclear, since the surviving records of the Harpers Ferry Paper Company and other sources often provide conflicting evidence. The Harpers Ferry Paper Company reported to the Commissioner of the Internal Revenue in 1925 that the company had equipped the mill on the Potomac with 10 water turbines, eight of which were paired together in four horizontal units (meaning six of the mill's flumes were presumably occupied by single or paired turbines). Six of the wheels were 33" "New American" horizontal turbines, manufactured by the Dayton Globe Company of Dayton, Ohio; two were 24" "New American" vertical models; and two were 33" horizontal turbines manufactured by the S. Morgan Smith Company of York, Pennsylvania.<sup>71</sup> The memory of the author of the report to the Internal Revenue may not have been accurate, as the Dayton Globe Company included in an 1892 catalog a letter from Thomas Savery in which he praised the turbines he had purchased from the company. In this letter, Savery mentioned that the Potomac mill had eight Dayton Globe 36" turbines in four paired units, driving eight wood

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Harpers Ferry Paper Company, Harpers Ferry Electric Light & Power Company, all of Harpers Ferry, W. VA." [dated Sept. 16, 1919], p.4, in Acc. 1534, Box 4, Folder 7, Savery Family Collection, Hagley; "Application to Federal Power Commission for Minor Project License at Harpers Ferry, West Virginia, Filed by Potomac Light and Power Company, April 14, 1965," p.1, in File, "File #4 - Harpers Ferry 2515," Potomac Edison Company, Hagerstown, MD.

<sup>71</sup>Letter, Harpers Ferry Paper Company to J. G. Bright, Deputy Commissioner, Commissioner of Internal Revenue, Washington, DC, April 8, 1925, Acc. 267, Box II, Folder 15, HFNHP.



grinders.<sup>72</sup> By 1908, the turbine complement consisted of eight 36" turbines (manufacturers and types not listed), two 27 and 1/2" turbines, and one 51" turbine. The 51" turbine was a vertical turbine manufactured by the Dayton Globe Company and purchased by the Harpers Ferry Paper Company in c.1905 to specifically power a generator for its electric plant.<sup>73</sup> A 57" vertical turbine manufactured by the S. Morgan Smith Company was added in 1923 to power another generator for the electric plant. The only water turbine still extant in the Potomac Power Plant, however, is the c.1905 Dayton Globe turbine.<sup>74</sup>

There is even less information available about the early generators the HFEL&P Co. used in its electric plant. One or more dynamos (generators) were in use as early as 1900, but nothing is known about what type these were or who manufactured them. A Sanborn fire insurance map of 1907 lists two dynamos for the mill. A local newspaper reported in 1909 that the company had

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<sup>72</sup>Dayton Globe Iron Works Company, "Catalogue of the New American Turbine," 1892, p. 46, located in Trade Catalog Collection, National Museum of American History Library, Smithsonian Institution, Washington, DC.

<sup>73</sup>The 51" turbine is listed in Harpers Ferry Paper Company [announcement of new bond issue], June 15, 1908, in File, "Harpers Ferry Paper Company," Allegheny Power Records Center, Dunbar, PA. The 51" Dayton Globe turbine was mistakenly dated to 1910 in Letter, Harpers Ferry Paper Company to J. G. Bright, Deputy Commissioner, Commissioner of Internal Revenue, Washington, DC, April 8, 1925, Acc. 267, Box II, Folder 15, HFNHP, but it appears in a list dating to 1908 in the source above, and it was given the date of 1905 on the Potomac Edison's maintenance card for the turbine (a copy is in Potomac Power Plant files, office of Chief, Interpretation & Cultural Resource Management, HFNHP.)

<sup>74</sup>"Report on Examination of Property Owned by the Jefferson Power Company, Shenandoah Pulp Company, Harpers Ferry Paper Company, Harpers Ferry Electric Light & Power Company, all of Harpers Ferry, W. VA." [dated Sept. 16, 1919], p.6, in Acc. 1534, Box 4, Folder 7, Savery Family Collection, Hagley. For a discussion of turbine technology in Harpers Ferry, see David T. Gilbert, A Walker's Guide to Harpers Ferry, West Virginia, (Harpers Ferry, WV: Harpers Ferry Historical Association, 1995, 5<sup>th</sup> ed.), pp.52-56, 68-69, and 78-81.

ordered a \$4,000 generator from Westinghouse, and in 1913, William Savery mentioned in a letter that the HFEL&P Co. had three dynamos.<sup>75</sup> There were only two by 1917, however, when the company purchased a new General Electric vertical generator with a capacity of 240 kilowatts to replace a smaller generator supplying electricity to Brunswick, and to complement a generator dedicated to Harpers Ferry.<sup>76</sup> In the winter of 1920-21, the HFEL&P Co. placed a small Westinghouse generator with a capacity of 200 kilowatts in the Shenandoah Pulp Mill as a backup to the equipment in the Potomac mill.<sup>77</sup>

Because of increased electrical load, the HFEL&P Co. purchased another new General Electric generator in 1923, a new GE switchboard, new transformers, and a new water turbine from S. Morgan Smith.<sup>78</sup> This is the generator which company officials claimed malfunctioned in January of 1925 and started the fire that destroyed most of the mill.

After the fire, the Harpers Ferry Paper Company (which by this time had been consolidated with the HFEL&P Co. and the Shenandoah Pulp Mill) decided to concentrate solely on the generation of electricity. It is unclear what happened to the equipment and turbines

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<sup>75</sup>*Farmers' Advocate*, Dec. 11, 1909; Sanborn Fire Insurance Map, Harpers Ferry, WV, 1907; Letter, William H. Savery to John S. Rossell, Feb. 7, 1913, Acc. 1534, Box 2, Folder 2, Savery Family Collection, Hagley.

<sup>76</sup>*Farmers' Advocate*, Aug. 4, 1917.

<sup>77</sup>*Farmers' Advocate*, March 20, 1920, and Jan. 8, 1921; "Report on Proposed Potomac River Dam," (dated Oct. 26, 1926), p.5, in Acc. 267, Box III, Folder 10, Savery Collection, HFNHP.

<sup>78</sup>Letter, no signature (presumably William H. Savery), to C.R. Thatcher, Feb. 25, 1925, Acc. 267, Box II, Folder 15, Savery Collection, HFNHP; Harpers Ferry Paper Company, General Manager's Report, Jan. 3, 1924, Acc. 267, Box II, Folder 4, Savery Collection, HFNHP.

previously devoted to pulp-making. Most of the machinery seems to have either been destroyed in the fire or scrapped afterwards. The water turbines probably survived the fire, but there are no company records as to their disposition. In May of 1925, four months after the fire, the Harpers Ferry Paper Company asked S. Morgan Smith to send someone to test the old Dayton Globe and S. Morgan Smith water turbines used for the electrical plant, presumably to make sure the fire had not damaged them.<sup>79</sup> The GE generator installed in 1917 seems to have survived the fire, although there is conflicting evidence.<sup>80</sup> The company did purchase a new GE 600 kilowatt-capacity generator after the fire, and installed it over the 1923 S. Morgan Smith water turbine.<sup>81</sup>

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<sup>79</sup>Letter, Harpers Ferry Paper Company to C.E. Etnier, York, PA, May 21, 1925, Acc. 267, Box II, Folder 6, Savery Collection, HFNHP.

<sup>80</sup>A newspaper article in May of 1925 referred to a 325 KVA (later referred to as a 300 KVA) generator that is to be installed in the plant, along with a new generator being shipped. The 325 (or 300) KVA generator is probably the 1917 GE generator being replaced after repairs from the fire, since an illustration of the 1917 generator in a 1920 General Electric catalog shows a generator cover similar to the cover currently in the Potomac Power Plant. Isabel Kern Flanagan's father worked in the mill at the time of the fire, and in an interview with a Harpers Ferry National Historical Park historian in 1995, she recalled that the small generator was salvaged from the fire, but had to be repaired before being put back in service. See *Farmers' Advocate*, May 23, 1925, and Sept. 5, 1925; General Electric, "Vertical Shaft Waterwheel-Driven Generators," (March 1920), p.19, and General Electric, "Waterwheel Generator Installations," (March 1921), p.5, Hagley Museum and Library, Wilmington, DE; Extract of Minutes of Board of Directors, Harpers Ferry Electric Light and Power Company, Dec. 4, 1925, in File, "Harpers Ferry Electric Light & Power," Allegheny Power Records Center, Dunbar, PA; Patricia Chickering, David T. Gilbert, and Bruce Noble, "Potomac Power Plant: A Summary Statement Concerning History, Architectural Integrity, and National Register Eligibility," (draft, Feb. 13, 1995), p.8, unpublished report located in office of Chief, Interpretation & Cultural Resource Management, HFNHP.

<sup>81</sup>*Farmers' Advocate*, Sept. 5, 1925; Extract of Minutes of Board of Directors, Harpers Ferry Electric Light and Power Company, Dec. 4, 1925, in File, "Harpers Ferry Electric Light & Power," Allegheny Power Records Center, Dunbar, PA; Letter, T.F. Cole, GE Canada to Kyle F. McGrogan, HFNHP, Feb. 26, 1992, in office of Chief, Interpretation & Cultural Resource

By the end of 1925, then, the Potomac Power Plant had in operation (or soon to be operable) a 1925 GE 600 kilowatt-capacity generator powered by a 1923 S. Morgan Smith 57" vertical water turbine, and a 1917 GE 240 kilowatt-capacity generator connected to a c.1905 Dayton Globe 51" vertical water turbine. The 1925 GE generator was also equipped with a water wheel governor manufactured by the Woodward Governor Company of Illinois. The governor helped to regulate the speed of the turbine by controlling the amount of water entering its runners. According to one historian, the Woodward company dominated the governor market in the 1920s.<sup>82</sup>

It is unclear whether the new GE switchboard installed in 1923 survived the fire, but a 1928 report described the switchboard then in place as a "5 panel G.E. switchboard complete with instruments, switches, bus structure and wiring" plus a "single street lighting panel with instruments, switches and a constant current regulator."<sup>83</sup> At some unknown date, the GE panels were replaced by the Westinghouse switchboard panels currently in the plant.

The major pieces of machinery and equipment in the Potomac Power Plant as of 1998 include the 1925 GE generator with the Woodward governor, the c.1905 Dayton Globe water turbine, and various Westinghouse switchboard panels. An appendix attached to this report, titled

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Management, HFNHP.

<sup>82</sup>Hay, Hydroelectric Development, p.89. See also various Woodward Governor Company trade catalogs in the Trade Catalog Collection, Library, National Museum of American History, and in Box, "Hydraulic Turbine Governors TE - WO," Engineering Division, National Museum of American History, Smithsonian Institution, Washington, DC.

<sup>83</sup>Vogelback, "Report and Appraisal...", p.22.

"A Survey of Select Machinery and Equipment in the Potomac Power Plant, 1998," by Robert C. Stewart, provides a detailed illustrated description of the components of the switchboard panels, as well as an analysis of the Woodward governor.

## **Conclusion**

The Potomac Power Plant is a very significant structure not only because it symbolizes, literally as well as figuratively, 200 years of water-powered industry in Harpers Ferry, but also because it represents an early transformation of an industrial site into a hydroelectric facility. The dam, power canal, waste weir, and various structural features, such as bricks and foundation stones from older industrial structures and Armory buildings, all connect the power house to an earlier era of Harpers Ferry's industrial past. Industry was revitalized in the town in the late nineteenth century with the building of the pulp mill, which gave employment to many in Harpers Ferry for almost forty years. The addition of a hydroelectric plant in the mill in 1899 was an early innovative adaptation to both the downward trend in the pulp market and the enormous potential of the water power of the Potomac River site. The mill on the Potomac thus physically became an amalgam of two technological processes between 1899 and 1925.

Other pulp and paper mills also converted all or parts of their facilities to hydroelectric operation after 1900, but as one historian of the era has claimed, "...all hydroelectric facilities tended to be somewhat novel in the years before World War I. Hydraulic, electrical, mechanical, structural, and architectural systems came together in ways that made each plant unique."<sup>84</sup> The

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<sup>84</sup>Hay, Hydroelectric Development, p.27.

plant built after the fire of 1925, perhaps because it included structural elements that had survived the fire, more closely resembled the nineteenth century industrial architecture of the older pulp mill. The variation was not dramatic, but such features as a gable roof and small decorative touches in the cornice and window treatments set the Potomac Power Plant apart somewhat from the steel-framed, flat-roof small hydroelectric facilities built elsewhere in the 1920s.<sup>85</sup>

The architectural style of the power house, its assortment of hydroelectric equipment, particularly the c.1905 Dayton Globe turbine and the 1925 Woodward governor, and the symbolism of early Harpers Ferry industry literally embodied in the building and its site make the Potomac Power Plant a significant industrial relic.

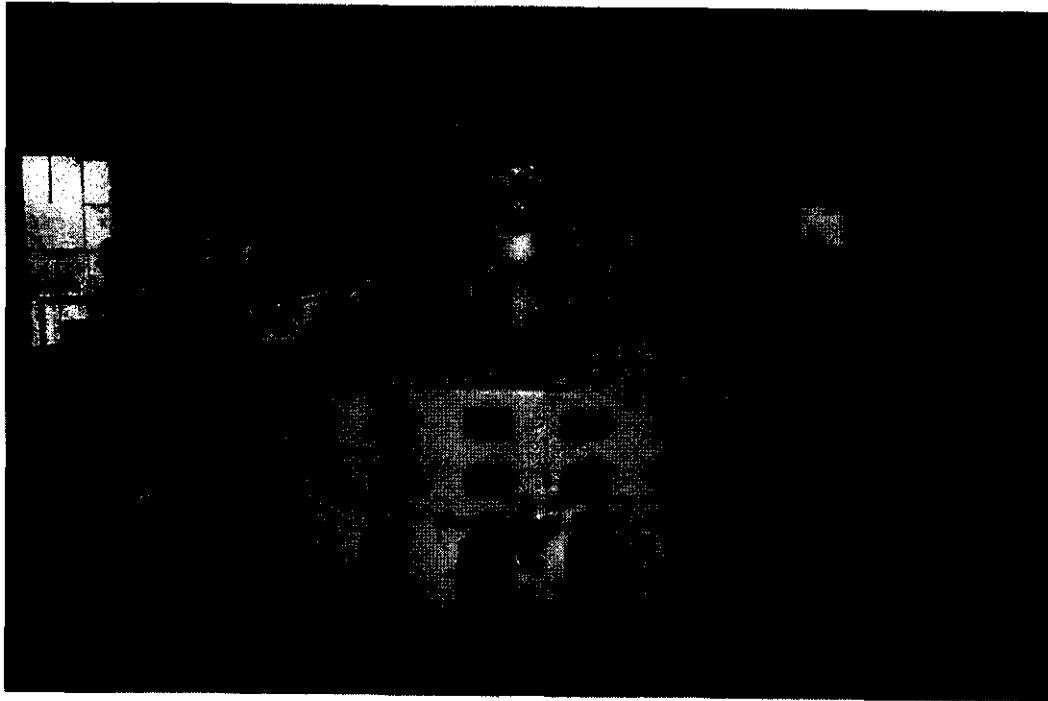
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<sup>85</sup>Hay, Hydroelectric Development, p.96.

## **APPENDIX:**

**A Survey of Select Machinery and Equipment in the Potomac Power Plant, 1998**

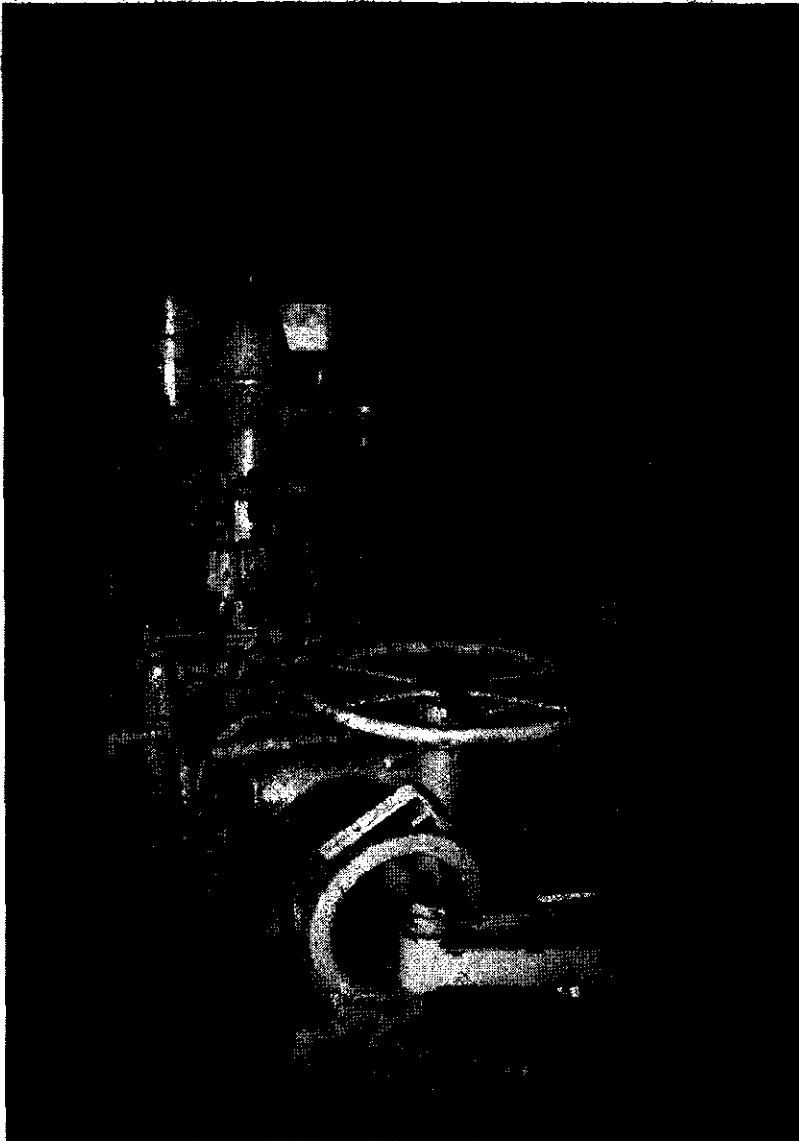
**Robert C. Stewart**



The 600 KW General Electric generator installed after the fire of 1925. It was powered by a 1923 model 900 horsepower S. Morgan Smith turbine.

Photographer: Bob Stewart, summer 1998





Left Foreground, view south- The Woodward Water Wheel Governor located adjacent to the generator regulates the speed and consequently, power output of the turbine. This unit is a type HR #5649. It has an output (for turning the control vanes on the turbine) of 10,000 ft-lbs from a power cylinder of 8.75" in diameter with a stroke of 12". The small upright vertical shaft in the approximate center of the photograph is connected to the turbine drive shaft and transmits the rotational speed to the governor. The motion is transmitted through a miter gear in the small spherical housing at the top of the shaft to the ogive shaped housing on the left. The ogive shaped housing contains the "fly-ball" governor. Note the horizontal hand-wheel. This is a manual override which enables the operator to adjust the control vanes through a train of gears. The control force is directed through the connecting rod (center of cylinder at the lower center of photo) to a lever arm (lower right of photo) then through the floor to the turbine inlet vanes below.

Photographer: Bob Stewart, summer 1998



View west of Woodward Governor. The main hydraulic power cylinder housing is at the lower center right of the photograph. A pilot valve is located on top of the power cylinder. The pilot valve directs hydraulic oil to either side of the piston housed in the power cylinder. Through a system of levers and cams the rotational speed of the turbine is converted into intermittent linear motion. If the turbine slows, a lever moves and slides a hydraulic pilot control valve which directs pressurized oil against one or the other side of a 8.75" piston. If the turbine is slowing due to higher loads, the governor opens the vanes, allowing more water in. If the turbine speeds up the opposite occurs, closing the vanes and slowing the turbine. The governor is a good example of a feedback control mechanism with a force multiplier that can take rotational speed of the turbine, multiply it, and convert it into linear motion with enough force to move the inlet vanes on the turbine.



View of the hydraulic pump providing power to the vane actuating mechanism. Note the site gage on the right side of the tank. The upper part of the tank contains an air cushion to prevent "hammer" in the system and minimized the effect of shock on components. The pump is driven by the electric motor at the lower left. The small box at the left of the tank monitors air pressure in the top of the tank and turns on the motor to maintain a set pressure.

Photographer: Bob Stewart, summer 1998



Viewing the panels from the front, from the left to right and top to bottom:  
Old Panel, Mostly unused.

**Station Panels:**

Station panel No. 1. Soapstone panel 90" high by 24" wide. Contains a Westinghouse frequency meter with a range of 55 to 65 hertz. Also, it has three Westinghouse meter relays, one over current, one under current and one ground leg. To the right of the ground relay meter there is a Westinghouse Group Annunciator, Type JM, style 21066C. This consists of a glass case enclosing about 12 "drops". If a fault occurs on a circuit being monitored by the annunciator, the magnet associated with the circuit is energized, pulls the latch back and allows the indicator to drop. Below the annunciator, centered on the panel is a "WL" switch associated with the annunciator. Below the "WL" switch is a rugged steel lever about 16" long (see detail on page 44). This connects via a series of bell cranks and levers to a spring loaded actuating mechanism on an oil filled circuit breaker. At the bottom of the panel are 3 annunciators housed in a 4 1/2" x 12" glass case. These monitor a number of parameters which are listed on plastic labels adjacent to the annunciators.

Station Panel No. 2 Soapstone panel 90" high and 24" wide. Contains Westinghouse over voltage and under voltage relays. These are a Type CV, under voltage relay, style 1056408C which was set for 100 volts and Type CV over voltage relay, which was set for 135 volts. Below the relays, centered on the panel, is a Westinghouse Type KM-44 Recording Ammeter, style HT12430-N31. This uses a paper strip chart to record the electrical current draw over time, on the station. Below the recording ammeter is a Westinghouse Watt-hour meter. This recorded the total power being produced by the station over time. Below the watt-hour meter are three annunciators in glass cases.

Next panel (to the right) is a blank sheet of plywood which replaced the station panel connected to the 240 KW generator.

Generator panel No. 2. Soapstone panel 90" high by 24" wide. At the top of the panel are four meters, a Westinghouse 0-300 amp ammeter, a 0-800 KW meter, a 0-200 amp ammeter and a 0-150 volt meter. Below the meters there are also 2 over current relays similar to the relays on

Panel No. 1. The next row of instrumentation contains a Westinghouse type D-3 DC relay, style 1542335, and a Westinghouse annunciator, type JM, style HT10882-1. A Westinghouse voltage relay, type BA86869-12 completes the instrumentation.

One interesting artifact is a small hole on the right side of the panel with a plate marked "syncroscope switch", evidence that the two generators were tied together at one time. A syncroscope is an instrument which enables an operator to distinguish the sine wave outputs (alternating current) of the two generators and synchronize them so the positive and negative swings of voltage occur together and do not "buck" each other.

The main breaker for isolating the generator from the control panel and the mail bus is centered on the panel below the instrumentation. It is levered and spring loaded similar to the breaker described above on panel No. 1.

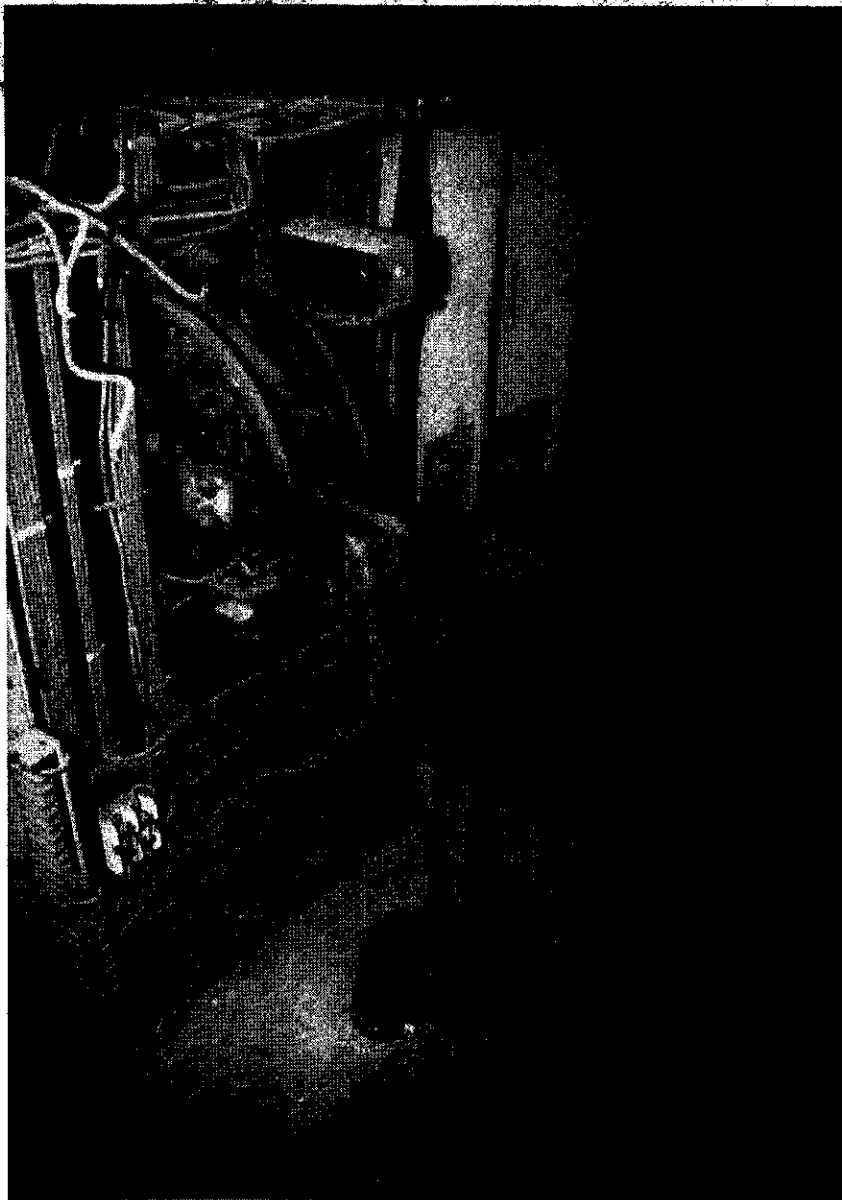
To the right of the generator panel is an open frame 90" by 24" which probable housed a generator panel for the 240 KW generator.

Photographer: Bob Stewart, Summer 1998



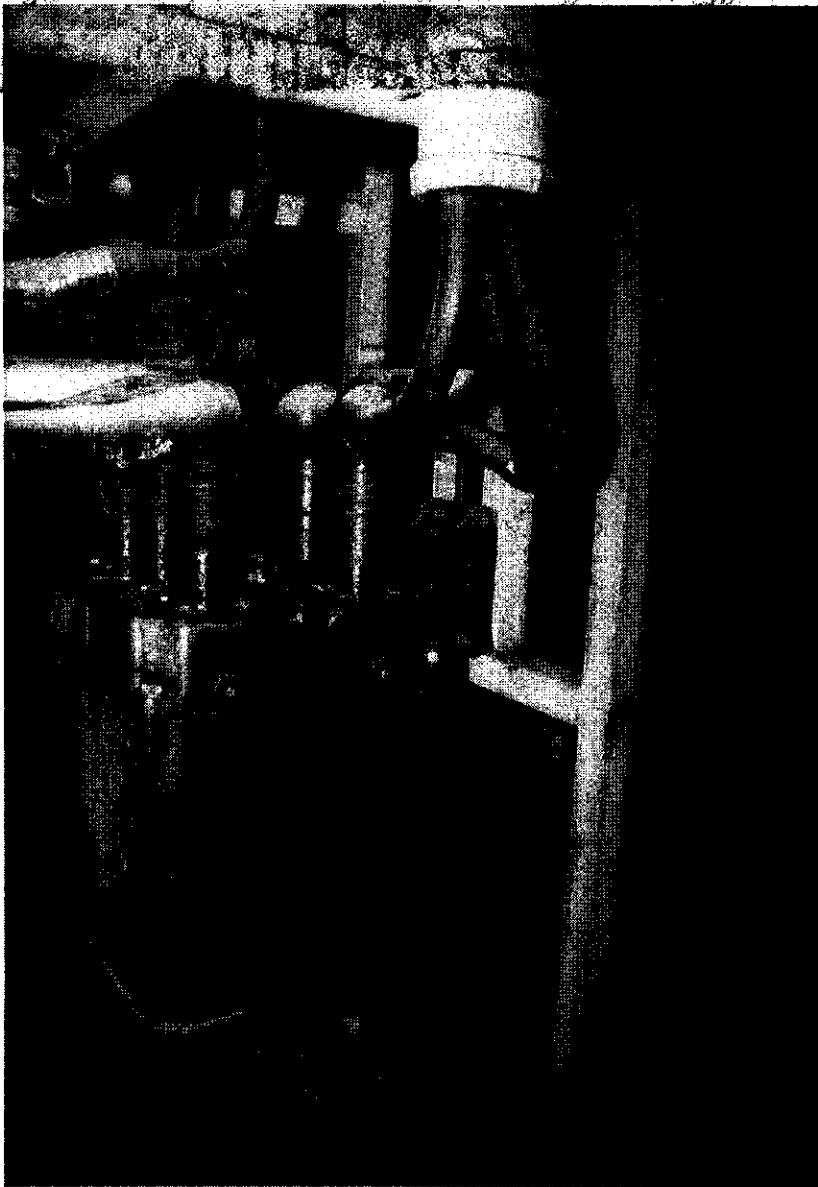
**Main Breaker Actuating Handle.** Located on Station Panel No. 1, this opens and closes the main breaker which connects the station to the power grid. Any switch which controls high-voltage at high amperage must be able to prevent arcing. When a switch conducting the power level being generated is opened an arc develops which ionizes the air in the vicinity which becomes conductive. Power continues to flow across the air gap. To prevent this the switch can be operated in an environment that contains a better insulator than air or it can be opened at a high speed. The main breakers in this station use both methods of arc suppression. A system of levers and springs insures that a small amount of force exerted by the operator is multiplied to quickly move the switch contacts which are sealed in a "can" and immersed in oil (see page 46).

**Photographer:** Bob Stewart, summer 1998



View of the rear of Station Panel No. 1 showing levers and bell cranks used to actuate the main breaker located on the bus frame behind the control panel.

Photographer: Bob Stewart, summer 1998

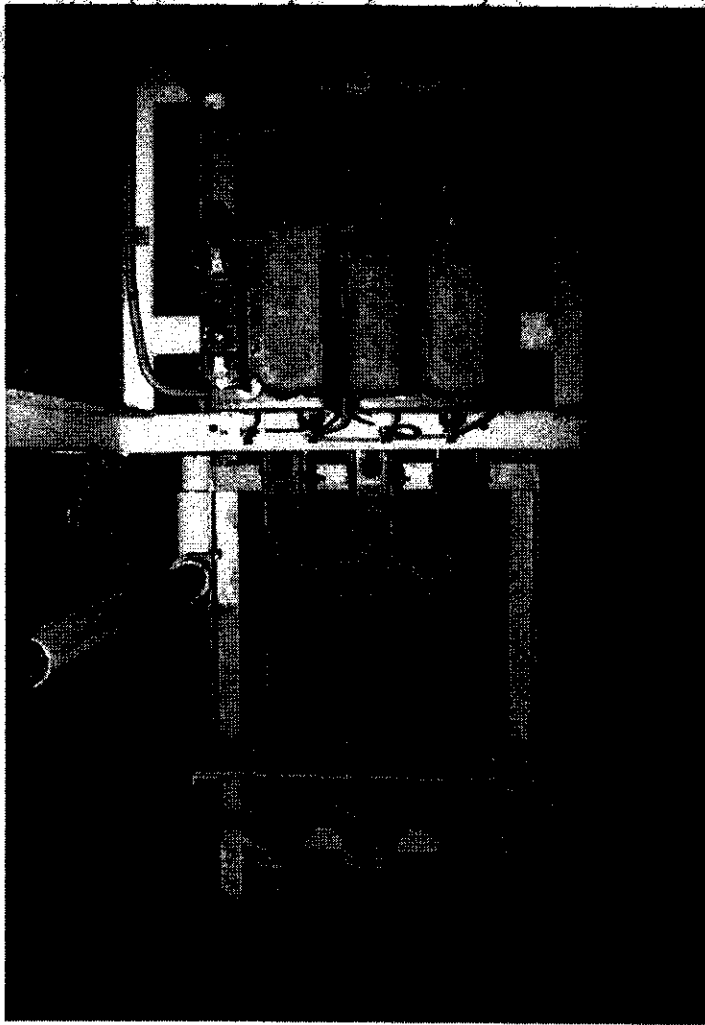


Main breaker located on bus frame. Note the shaft and bell crank at the lower right which comes from the control panel and actuating handle. The box or "can" contains a switch immersed in oil. The oil has been drained from the box to alleviate possible concerns about PCB contaminants. (See sheet 44)





Main bus on bus frame, located behind the soapstone control panels.



Bus frame located behind control panel. This bay houses instrument transformers (oblong boxes at top) which reduce voltage and current to values which can be handled by the instruments on the control panel. The cylindrical objects at the bottom are lightning arresters.

Photographer: Bob Stewart, summer 1998



Exciter field resistance support frame. This mounts a large resistance grid, a large multi-element rheostat. These can be manually adjusted to create a resistance which can be put in series with the with the field winding on the exciter generator to control the overall power output of the main generator.

Potomac Power House - Harper's Ferry, West Virginia - Control Equipment list

STATION PANEL #1

Westinghouse Overcurrent Relay - Style 701127A - Tagged as "A phase" - checked 4-25-88

Westinghouse Frequency Meter range 55-65 hertz - size 5 1/2 x 6"

Westinghouse Group Annunciator - Type JM 20166C

Westinghouse Type WL Relay - 48 v dc - Patent #1878602

Westinghouse Recording ac ammeter - Type KM-44 - Style HT 12430-N31

Westinghouse Type CV - Under Voltage relay - style 1056408C (set for 100 volts)

Westinghouse Type CV Over Voltage relay Style 1056412C (set for 135 volts)

STATION PANEL #2

Westinghouse Voltage Relay type BA 86869-12

Westinghouse Annunciator Type JM - Style HT 10882-1

BACK (BUS) FRAME) Back Frame

Oil Circuit Breaker (load side) Type F-124 rated at 15000 V; 600 A S/N 940017

Oil Circuit Breaker (line side) no identification plate

Lightning Arrestors - porcelain housing - GE

Instrument transformers, potential transformers and current transformers

EXCITER FIELD RESISTANCE SUPPORT FRAME

Large resistance grid, probably nichrome elements

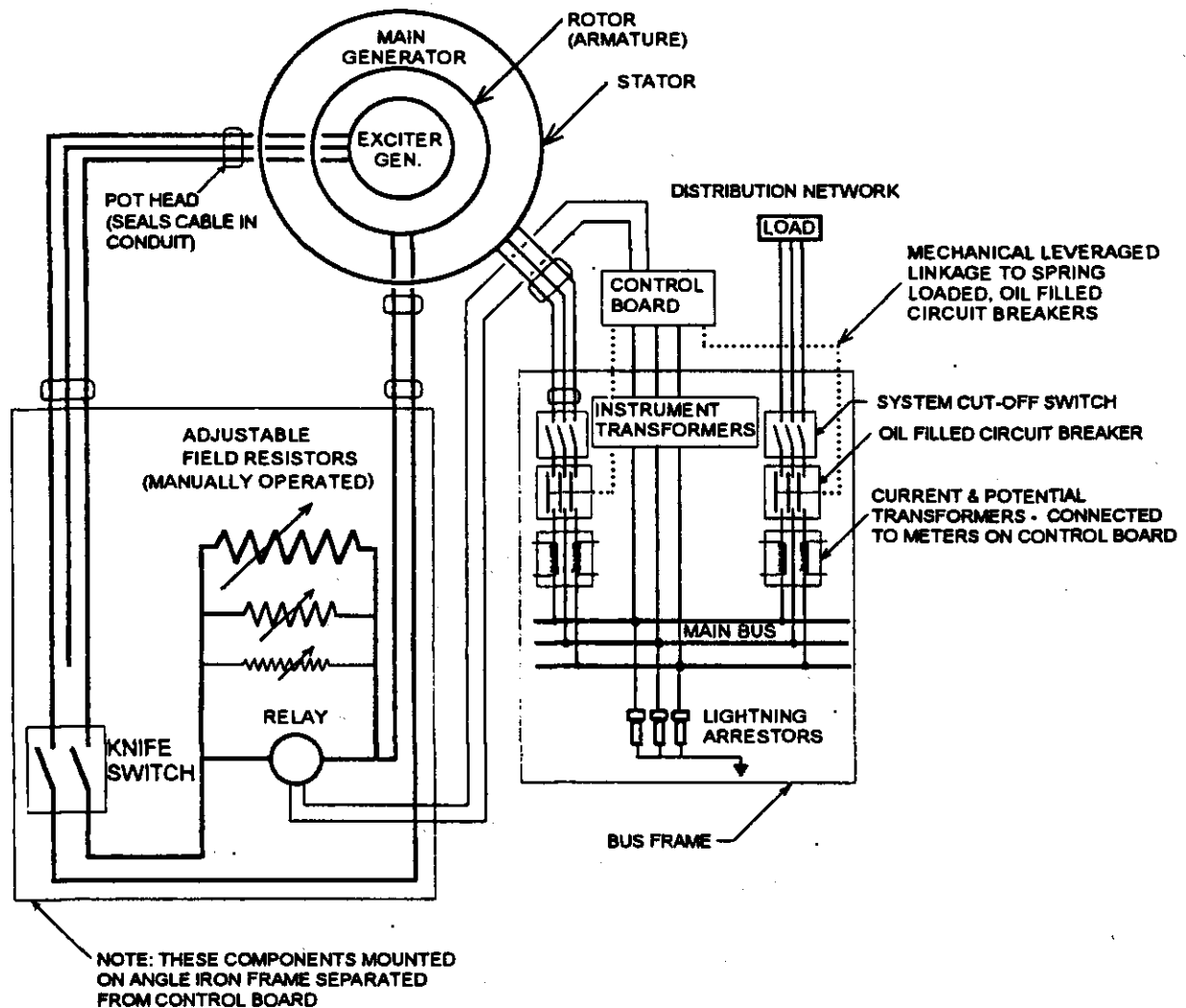
Chain driven control wheel

Ceramic potted rheostats (2)

Knife Switch

Turbine Governor: Woodward Water Wheel governor - Type HR - Ft/lbs. 10000  
#5649 - size 8.75 x 12

# POTOMAC POWER PLANT - HARPERS FERRY VIRGINIA Preliminary Investigation of Extant Turbine and Generator



PICTORIAL/SCHEMATIC OF TURBO-GENERATOR

R.C. Stewart  
6-24-98